KING SAUD UNIVERSITY
COLLEGE OF COMPUTER & INFORMATION SCIENCES
DEPT OF COMPUTER SCIENCE

CSC311 Computer Algorithms
Second Semester 1444
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Tutorial #1

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1. **Given** the matrices A and B of sizes m x l and l x n respectively.

   a) Write the pseudocode to compute the matrix C = A x B
   b) What is the complexity of the code that you wrote?

2. Consider the following code fragment,

```
x ←1
for i ← 1 ..n step 3 do
x ←x +2
print x
```

What value of x will be printed (express it as a function of n)

3. Consider the following code fragment,

```
x ←5
i ← 1
While (2 i  < N) do
i ←i +2;
x ←x +3;

print x
```

What value of x will be printed (express it as a function of N)

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4. Show that 6n + 3n log(n^5) = O(n logn). Find the appropriate values of C and n_0 .

5. Show that $2n^3 - 10n^2 + 2$ =O(n^3). Find the appropriate values of C and n_0.

6. Prove or disprove the statement, 2^{n+2} = O(n^2).

7. Prove that 3^n = O(n !). Find the appropriate values of C and n_0.

8. Compare the order of growth for 3^{2n} and 5^n.

1. Given the matrices A and B of sizes m x l and l x n respectively.

   a) Write the pseudocode to compute the matrix C = A x B

   b) What is the complexity of the code that you wrote?

a)

```
for i <—1…m
      for  j <—1…n
      C[i , j] = A[i , 1] * B[1 , j]
      return C
```

b)

$\sum_{i=1}^{m} 1 + 1 = m+1$	for i <—1…m
$\sum_{i=1}^{m}\sum_{j=1}^{n} 1 + 1$	for j <—1…n
mn	C[i , j] = A[i , 1] * B[1 , j]
1	return C

$O(mn)$

2. Consider the following code fragment,

x ← 1
for i ← 1 ..n step 3 do
x ← x +2
print x

What value of x will be printed (express it as a function of n)

2 * n/3 + 1

3. Consider the following code fragment,

```
x ←5
i ←1
While (2 i  < N) do
i ←i +2;
x ←x +3;

print x
```

What value of x will be printed (express it as a function of N)

$5 + 3\lfloor (N/2 * 1/2) \rfloor$

4. Show that 6n + 3n log(n^5) = O(n logn). Find the appropriate values of C and n_0 .

$6n + 15n \log(n) \leqslant 6n \log(n) + 15n \log(n)$

$\leqslant 21n \log(n)$

C = 21 $n_0 = 2$ So $6n + 3n \log(n^5)$ is $O(n \log(n))$

5. Show that $2n^3 - 10n^2 + 2 = O(n^3)$. Find the appropriate values of C and n_0.

$2n^3 - 10n^2 + 2 \leqslant |2|n^3 |-10|n^3 |+2|n^3$

$\leqslant 2n^3 + 10n^3 + 2n^3$

$\leqslant 14n^3$

C=14 n_0=1

6. Prove or disprove the statement, $2^{n+2} = O(n^2)$.

$$\lim_{n \to \infty} f(n)/g(n) \overset{?}{\leqslant} C$$

$$\lim_{n \to \infty} 2^{n+2}/n^2 \nleqslant C$$

$$\lim_{n \to \infty} 2^{n+2}/n^2 = \infty$$

So it's not $O(n^2)$

Disproved

7. Prove that $3^n = O(n!)$. Find the appropriate values of C and n_0.

$3^n \leqslant C\, n!$ $\quad\quad n \geqslant n_\circ$

$3^n = 3*3*3*\ldots*3$ n times

$C\, n! = 1*2*3*\ldots*n$

$6\, n! = (2*3)*1*2*3*\ldots*n$ $\quad\quad 3^n = 3*3*3*\ldots*3$

$\quad = 3*4*3*\ldots*n$ $\quad\quad 6n! = 3*4*3*\ldots n$ $\quad \geqslant$

$3^n \leqslant 6n!$

$C = 6$ $\quad\quad n_\circ = 1$

$3^n = O(n!)$

8. Compare the order of growth for 3^{2n} and 5^n.

3^{2n} - 9^n

$9^n \leqslant C * 9^n \quad n \geqslant n_0$

$9^n \leqslant (9) * 9^n$

$C=9 \quad n_0=1$

3^{2n} is $O(9^n)$

$5^n \leqslant C * 5^n \quad n \geqslant n_0$

$5^n \leqslant 2 * 5^n$

$C=2 \quad n_0=1$

5^n is $O(5^n)$

Both has exponential order of growth